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BEFORE THE BOARD OF PATENT APPEALS AND INTERFERENCES

Application Number: 09/824,301
Filing Date: April 02, 2001
Appellant(s): BODE ET AL.

WILLIAMS, MORGAN & AMERSON, P.C.
For Appellant

EXAMINER'S ANSWER

This is in response to the appeal brief filed May 19th 2005.

(1) Real Party in Interest

A statement identifying the real party in interest is contained in the brief.

(2) Related Appeals and Interferences

A statement identifying the related appeals and interferences which will directly affect or be directly affected by or have a bearing on the decision in the pending appeal is contained in the brief.

(3) Status of Claims

The statement of the status of the claims contained in the brief is correct.

(4) Status of Amendments After Final

The appellant's statement of the status of amendments after final rejection contained in the brief is correct.

(5) Summary of Invention

The summary of invention contained in the brief is correct.

(6) Issues

The appellant's statement of the issues in the brief is correct.

(7) Grouping of Claims

The rejection of claims 1-7, 11-15, 17, 18, 22-26, 28-37 and 41-44 stand or fall together because appellant's brief does not include a statement that this grouping of claims does not stand or fall together and reasons in support thereof. See 37 CFR 1.192(c)(7).

(8) Claims Appealed

The copy of the appealed claims contained in the Appendix to the brief is correct.

(9) Prior Art of Record

6,169,931	Runnels	1-2001
2001/0039462	Mendez et al.	11-2001
2002/0147960	Jevtic et al.	10-2002
5659467	Vickers	8-1997
6110214	Klimasauskas	8-2000

(10) Grounds of Rejection

The following ground(s) of rejection are applicable to the appealed claims:

Claims 1, 2, 4, 6, 11-13, 17, 22-24, 28, 30, 31, 34, 41, and 42 are rejected under 35 U.S.C. 102(e) as being anticipated by U.S. Pat. No. 6,169,931 to Runnels.

Referring to claims 1 and 28, Runnels teaches a method for initializing process controllers based on tool event data, comprising:

providing a tool having a process controller adapted to employ a control model to control an operating recipe of the tool (Abstract; Col. 1, lines 13-19; Col. 7, lines 3-8; Col. 9, lines 24-29); a tool adapted to process wafers in accordance with the operating recipe (Abstract); receiving a tool event notification and initializing the control model in response to receiving the tool event notification (Fig. 9, element 902; Col. 14, lines 10-34).

Referring to claims 2 and 31, Runnels teaches the system above, wherein initializing the control model comprises: estimating a control variable value (Fig. 9, element 907, "form a new guess for the optimal recipe"); and initializing the control model based on the estimated control variable (Fig. 9, element 902 is based on element 907; Col. 14, lines 10-34).

Referring to claims 4 and 34, Runnels teaches the system above, wherein the tool is a CMP tool adapted to planarize a semiconductor wafer (Abstract), and estimating the control variable includes estimating a material removal rate (Col. 2, lines 45-51; Col. 7, lines 3-25).

Referring to claims 6 and 17, Runnels teaches the system above further comprising: performing a qualification procedure on the tool in response to receiving the tool event notification to determine a control variable (Fig. 9); and initializing the control model based on the control variable (Fig. 9, element 902 is based on element 908).

Referring to claims 11, 22, and 30, Runnels teaches the system above, wherein receiving the tool event notification comprises receiving a notification of a tool calibration (Col. 7, lines 5-12).

Referring to claims 12, 23, and 41, Runnels teaches the system above, wherein the tool is a CMP tool adapted to planarize a semiconductor wafer (Abstract), and receiving the tool event notification comprises receiving a notification of when the polishing pad is replaced (Col. 7, lines 13-25).

Referring to claims 13, 24, and 42, Runnels teaches the system above, wherein the tool is a CMP tool adapted to planarize a semiconductor wafer (Abstract), and receiving the tool event notification comprises receiving a notification of when the polishing pad is conditioned (Col. 7, lines 13-25).

Claims 1, 2, 4, 6, 7, 11, 13, 17, 18, 22, 24, 28, 29, 30, 31, 34, and 42 are rejected under 35 U.S.C. 102(e) as being anticipated by U.S. Pub. No. 2001/0039462 to Mendez et al.

Referring to claims 1 and 28, Mendez et al. teaches a method for initializing process controllers based on tool event data, comprising:

providing a tool having a process controller adapted to employ a control model to control an operating recipe of the tool (Page 2, paragraphs 13-20); a tool adapted to process wafers in accordance with the operating recipe (Page 1, paragraph 3; page 2, paragraph 19); receiving a tool event notification and initializing the control model in response to receiving the tool event notification (See page 4, paragraphs 51-52 and then paragraph 50).

Referring to claims 2 and 31, Mendez et al. teaches the system above, wherein initializing the control model comprises: estimating a control variable value (Fig. 2, element 51, PSM parameters are predictive software model parameters); and initializing the control model based on the estimated control variable (Fig. 2, element 51; Page 4, paragraph 50).

Referring to claims 4 and 34, Mendez et al. teaches the system above, wherein the tool is a CMP tool adapted to planarize a semiconductor wafer, and estimating the control variable includes estimating a material removal rate (Page 5, paragraph 58).

Referring to claims 6 and 17, Mendez et al. teaches the system above further comprising: performing a qualification procedure on the tool in response to receiving the tool event notification to determine a control variable (Page 5, paragraph 58); and initializing the control model based on the control variable (Fig. 2, element 51; Page 4, paragraph 50).

Referring to claims 11, 22, and 30, Mendez et al. teaches the system above, wherein receiving the tool event notification comprises receiving a notification of a tool calibration (Col. 5, paragraph 57).

Referring to claims 13, 24, and 42, Mendez et al. teaches the system above, wherein the tool is a CMP tool adapted to planarize a semiconductor wafer, and receiving the tool event notification comprises receiving a notification of when the polishing pad is conditioned (Page 5, paragraph 57).

Referring to claims 7 and 18, Mendez et al. teaches the system above, wherein the tool is a CMP tool adapted to planarize a semiconductor wafer, and performing the qualification procedure comprises processing a test wafer in the CMP tool to determine a blanket wafer removal rate (Fig. 4-5; Page 5, paragraph 58 – Page 6, paragraph 64).

Referring to claim 29, Mendez et al. teaches the system above, further comprising a process control server adapted to send the tool event notification to the process controller (Fig. 21, ethernet).

Claim Rejections - 35 USC § 103

The text of those sections of Title 35, U.S. Code not included in this action can be found in a prior Office action.

Claims 35-37 are rejected under 35 U.S.C. 103(a) as being unpatentable over U.S. Pub. No. 2001/0039462 to Mendez et al. as applied to claim 29 above, and further in view of U.S. Pub. No. 2002/0147960 to Jevtic et al.

Referring to claim 35 and 36, Mendez et al. teaches the system above further comprising: performing a qualification procedure on the tool in response to receiving the tool event notification to determine a control variable (Page 5, paragraph 58); and initializing the control model based on the control variable (Fig. 2, element 51; Page 4, paragraph 50).

Referring to claim 37, Mendez et al. teaches the system above, wherein the tool is a CMP tool adapted to planarize a semiconductor wafer, and performing the qualification procedure comprises processing a test wafer in the CMP tool to determine a blanket wafer removal rate (Fig. 4-5; Page 5, paragraph 58 – Page 6, paragraph 64).

Mendez et al. fails to teach scheduling a qualification procedure on the tool.

However, Jevtic et al. teaches analogous art, including scheduling for the periodic removal of wafers for testing (Page 1, paragraph 0005 of Jevtic et al.).

Therefore, it would have been obvious to one of ordinary skill in the art at the time that the invention was made to modify the system of Mendez et al. to include the scheduling of Jevtic et al.

One of ordinary skill in the art would have been motivated to combine these references because Jevtic et al. teaches computing an optimal schedule for moving wafers into defect control stations (Page 1, paragraph 0011 of Jevtic et al.).

Claims 3, 5, 32, and 33 are rejected under 35 U.S.C. 103(a) as being unpatentable over U.S. Pub. No. 2001/0039462 to Mendez et al. as applied to claims 1 and 31 above, and further in view of U.S. Pat. No. 5,659,467 to Vickers.

Mendez et al. teaches all the limitations of the claims above and further, Mendez et al. generally teaches a system and method for predicting software models using material-centric process instrumentation where a material is being processed (Page 1, paragraph 2).

Referring to claims 3, 5, 32, and 33, Mendez et al. fails to teach the system above, wherein the tool is an etch tool or a deposition tool adapted to etch features or form a layer on a wafer and the control variable of the estimation is an etching rate or deposition rate.

However, referring to claims 3, 5, 32, and 33, Vickers teaches analogous art, wherein a tool is an etch tool or a deposition tool adapted to etch features or form a layer on a wafer and a estimating a control variable comprising estimating an etching rate or deposition rate (Col. 5, lines 32-44).

Therefore, it would have been obvious to one of ordinary skill in the art at the time that the invention was made to modify the teachings of Mendez et al. with the teachings of Vickers.

One of ordinary skill in the art would have been motivated to combine these references because Vickers teaches a system that provides the ability to perform opportunistic maintenance of the equipment by identifying coefficients that are reaching limits, coefficients that are changing rapidly, and coefficients that are changing in parallel for supervised equipment such as deposition and etch equipment (Col. 5, lines 32-44; Col. 9, lines 50-56).

Claims 14, 15, 25, 26, 43, and 44 are rejected under 35 U.S.C. 103(a) as being unpatentable over U.S. Pub. No. 2001/0039462 to Mendez et al. as applied to claims 1, 17, and 28 above, and further in view of U.S. Pat. No. 6,110,214 to Klimasauskas.

Mendez et al. teaches all the limitations of the claims above and further, Mendez et al. generally teaches a system and method for predicting software models using material-centric process instrumentation where a material is being processed (Page 1, paragraph 2).

Referring to claims 14, 15, 25, 26, 43, and 44, Mendez et al. fails to teach the system above, wherein the tool is an etch tool or a deposition tool having a chamber and the tool event notification comprises a notification that the chamber has been cleaned.

However, referring to claims 14, 15, 25, 26, 43, and 44, Klimasauskas teaches analogous art, wherein the tool is an etch tool or a deposition tool having a chamber and the tool event notification comprises a notification that the chamber has been cleaned (Col. 4, lines 40-61; Col. 10, lines 4-6; Col. 1, lines 55-57).

Therefore, it would have been obvious to one of ordinary skill in the art at the time that the invention was made to modify the teachings of Mendez et al. with the teachings of Klimasauskas.

One of ordinary skill in the art would have been motivated to combine these references because Klimasauskas teaches a system for modeling and optimizing the maintenance of semiconductor processing equipment (Col. 1, lines 12-15). Furthermore, Klimasauskas teaches the system determines the type of maintenance to be executed and the extent to which maintenance can be postponed by changing process variables. Further still, Klimasauskas teaches the system determines potential modifications to process variables to improve the current performance of the processing equipment (Col. 3, lines 34-51).

(11) Response to Argument

A. Applicant argues that the term tool event is defined to mean periodic preventive maintenance procedure or calibration to keep the tool in optimum or acceptable operating condition in page 4, lines 10-17. The examiner respectfully disagrees. For the Board's convenience the examiner has reproduced the cited portion below:

> "Commonly, a processing tool undergoes periodic preventative maintenance procedures or calibrations to keep the tool in optimum operating condition. For example, polishing tools include polishing pads that are periodically conditioned or replaced. Etch tools and deposition tools are periodically cleaned using both in situ cleans or complete disassembly cleans. Steppers are periodically calibrated to maintain alignment accuracy and exposure dose consistency. The discrete maintenance activities, collectively referred to as tool events, often cause step changes in the processing characteristics of the tool. The control routines implemented"

The examiner respectfully submits that the portion cited by applicant fails to provide any explicit definition for the term "tool event".

The examiner further notes applicant's description of the term "tool events" or the term "tool event notification" in the cited portions below:

> "Various tool events, such as maintenance procedures (e.g., chamber cleaning, polishing pad conditioning, consumable item replacement), calibrations, etc., may affect the operating characteristics of the tool 30, thus causing difficulty for the process controller 80 in maintaining the stability of its control algorithm. In some instances, it may take the process controller 80 numerous iterations to account for the operating characteristic change due to the tool event. Product processed during the interim may be defective. In other cases, it may be entirely impossible for the process controller 80 to handle the operating characteristic change." (Page 9, lines 4-10).

> "Turning now to Figure 2, a simplified flow diagram of a method for initializing tool controllers based on tool event data is provided. In block 200, a tool 30 having a tool controller 80 adapted to control an operating recipe of the tool is provided. In block 210, a tool event notification is received. The tool event notification may be associated with the performance of a preventative maintenance procedure (e.g., chamber cleaning, polishing pad conditioning, consumable item replacement), calibration, etc. In block 220, the tool" (Page 11, lines 9-14).

The examiner respectfully submits that the phrase "Various tool events, ***such as*** maintenance procedures (e.g., chamber cleaning, polishing pad conditioning, consumable item replacement), calibrations, ***etc.***," cannot be interpreted as an explicit definition of the term "tool events".

B. Applicant argues that Runnels does not teach a tool event. The examiner respectfully disagrees. The examiner respectfully submits that, in view of the instant specification, the optimization for the solution for the optimal tool recipe is a tool event. Runnels clearly teaches optimization of CMP polishing recipe as, for example, "changing the pressure or speed settings of the tool configuration or varying the geometric configuration of the CMP polish tool such as the pad inner/outer radii and the sweep arm" (See Col. 9, lines 12-37). The examiner respectfully submits that the optimal solution for "changing the pressure or speed settings of the tool configuration or varying the geometric configuration of the CMP polish tool such as the pad inner/outer radii and the sweep arm" is a tool event.

C. Applicant argues that Runnels does not teach or suggest receiving a tool event notification. The examiner respectfully disagrees. Runnels clearly shows receiving the tool event notification in figure 9 (converge or not converge). Runnels clearly teaches receiving a event notification that the solution for the optimal tool recipe does not converge (Col. 14, lines 10-34). Examiner respectfully asserts that the event notification that the solution for the optimal tool recipe does not converge is a tool event notification.

D. Applicant argues that Runnels does not teach or suggest initializing a control model of a processing tool in response to receiving the tool event notification. The examiner respectfully disagrees. Runnels does teach initializing a control model of a processing tool in response to receiving the tool event notification in Fig. 9, element 902 and Col. 14, lines 10-34. Runnels clearly teaches resetting the control model in response to receiving an event notification of the tool, wherein Runnels teaches resetting the number of wafers polished in the control model to zero (Fig. 9, element 902) in response to receiving a event notification that the solution for the

optimal tool recipe does not converge (Col. 14, lines 10-34). Examiner respectfully asserts that the resetting of the number of wafers polished in the control model is initializing the control model.

E. Applicant argues that Mendez et al. fails to teach a tool event. The examiner respectfully disagrees. Mendez et al. clearly teaches a tool event in page 4, paragraphs 51-52. For the Board's convienence the examiner has reproduced the cited portion, in part, below:

> "As previously mentioned above, the MPI system of the PSM also includes a feed-back control loop 46. Post CMP data 58 can be input to the PSM and recorded in the historical database 48. The specific data written to database 48 is recorded as being related to either CIM or MES material identification. Input of the post CMP data triggers the activation of the slow reacting feed-back control loop 46 which updates a run-to-run parameter by calculating a run-to-run calculation in the logic component 60 of the feed back loop 46. Any adjustments in the run-to-run parameters are activated in the trigger component 62 of the feed back loop 46 which updates tool drift parameters 64. Tool drift parameters adjust for the natural drift in tool polishing characteristics which include, but are not limited to, removal rate, uniformity, slurry characteristics, and pad characteristics."

The examiner respectfully submits that, in view of the instant specification, adjustments of run-to-run parameters which updates tool drift parameters in response to the input of post CMP data, wherein Mendez et al. clearly teaches that tool drift parameters "adjust for the natural drift in tool polishing characteristics which include, but are not limited to, removal rate, uniformity, slurry characteristics, and pad characteristics" (Page 4, paragraph 52) is a tool event.

F. Applicant argues that Mendez et al. fails to teach receiving a tool event notification. The examiner respectfully disagrees. Mendez et al. clearly teaches that any adjustments in the run-to-run parameters are activated in the trigger component 62 of the feed back loop 46 (page 4, paragraph 52), wherein the updated tool drift parameters that are triggered are input as parameters to the logic component 52 of the feed forward loop and are used with a mathematical algorithm to dynamically calculate polishing process parameters (Page 4, paragraph 50). The

examiner respectfully submits that the input of the updated tool drift parameters to logic component 52 is receiving a tool event notification.

G. Applicant argues that Mendez et al. fails to teach initializing a control model of a processing tool in response to receiving the tool event notification. The examiner respectfully disagrees. Mendez et al. clearly teaches the updated tool drift parameters that are triggered are input as parameters to the logic component 52 of the feed forward loop and are used in a mathematical algorithm to calculate process parameters that modify a set of baseline recipes (See page 4, paragraphs 51-52 and then paragraph 50). Examiner respectfully asserts that the triggering of parameters input to a mathematical algorithm to modify a recipe is initializing the control model in response to receiving the tool event notification.

For the above reasons, it is believed that the rejections should be sustained.

Respectfully submitted,

SPS

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June 15, 2005

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